Claims

1. A plasma processing apparatus comprising means for striking a plasma in a chamber having a gas inlet and a support for a substrate, wherein the apparatus further comprises attenuation means for reducing and/or homogenising the ion flux from the plasma substantially without affecting the radical number density.

2. A plasma processing apparatus according to claim 1, further comprising means for providing alternating etch and deposition steps.

3. A plasma processing apparatus according to claim 1 ~~or 2~~, further comprising a further means for striking a plasma which is positioned below the level of the attenuation means.

4. A plasma processing apparatus according to ~~any preceding claim~~ claim 1 wherein at least a portion of the chamber is formed of a dielectric material.

5. A plasma processing apparatus according to claim 4, wherein the attenuation means is positioned at about the mid-point of the portion formed of a dielectric material.

6. A plasma processing apparatus according to claim 4 ~~or claim 5~~, wherein an antenna is positioned externally adjacent the dielectric portion to create a plasma production region in the chamber.

7. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means comprises a magnetic portion.

8. A plasma processing apparatus according to claim 7, wherein the attenuation means comprises one or more permanent magnets.

9. A plasma processing apparatus according to claim 7 ~~or 8,~~ wherein the attenuation means comprises means for creating an electromagnetic field.

10. A plasma processing apparatus according to claim 9 wherein said means for creating an electromagnetic field comprises an array of electromagnetic coil groups separately orientated to create respective magnetic fields which are angularly offset with respect to one another.

11. A plasma processing apparatus according to claim 10 wherein three sets of coil groups are provided which are designed to create magnetic fields which are offset from one another by 60 degrees or 180 degrees.

12. A plasma processing apparatus according to ~~any one of claims 9 to 11~~ claim 9, wherein the means for creating an electromagnetic field is capable of creating a variable field.

13. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means comprises one or more tubular members carrying magnets and/or conductors to form an electromagnet.

14. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means is temperature controlled.

15. A plasma processing apparatus according to claim 14, including a distribution member to distribute a cooling

medium to the attenuation means.

16. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means comprises one or more strong magnets preferably positioned outside the plasma chamber.

17. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means comprises a sheet member having a plurality of apertures therein.

18. A plasma processing apparatus according to claim 16, wherein the sheet member is heated.

19. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein a means for striking the plasma is positioned above the level of the attenuation means and a means for striking the plasma is positioned below the level of the attenuation means.

20. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, further comprising two dielectric portions of the chamber, wherein the attenuation means is positioned therebetween.

21. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, wherein the attenuation means is designed to produce a high field capable of significantly reducing the ion flux during the etch step.

22. A plasma processing apparatus according to ~~any preceding claim~~ claim 1, further comprising means for guiding neutral radicals.

23. A plasma processing apparatus according to claim 22, wherein the guiding means is positioned between the

attenuation means and the substrate.

24. A plasma processing apparatus according to claim 22 ~~or 23~~, wherein at least a part of the guiding means is positioned close to the substrate.

25. A plasma processing apparatus substantially as hereinbefore described, with reference to, and as illustrated in, the accompanying drawings.

26. An attenuation means for use in a plasma processing apparatus having means for striking a plasma in a chamber, wherein the attenuation means is capable of reducing and/or homogenising the ion flux from the plasma substantially without affecting the radical number density.

27. An attenuation means according to claim 25, comprising a magnetic portion.

28. An attenuation means according to claim 27, comprising one or more permanent magnets and/or means for creating an electromagnetic field.

29. A guiding means for use in a plasma processing apparatus having means for striking a plasma in a chamber, wherein the guiding means is capable of guiding neutral radicals of an etch gas introduced into the chamber.

30. A guiding means according to claim 29, formed with one or more apertures therein.

31. A guiding means according to claim 30, wherein the apertures are shaped in relation to a pattern exposed on a substrate.

32. A guiding means according to claim 29 ~~any one of claims 29 to 31~~ which comprises a disc.

33. A guiding means according to ~~any one of claims 29 to 32,~~ claim 29 wherein, in use, at least part thereof is parallel to a substrate positioned in the chamber.

34. A plasma processing apparatus comprising means for striking a plasma in a chamber having a gas inlet and a support for a substrate, wherein the apparatus further comprises a guiding means according to ~~any one of claims 29 to 33~~ claim 29.

35. A method of etching a feature in a substrate in a chamber, the method comprising striking a plasma in the chamber and reducing and/or homogenising the ion flux from the plasma substantially without affecting the radical number density.

36. A method according to claim 35, further comprising the step of alternately etching the substrate and depositing a passivation layer on the substrate.

37. A method according to claim 36, wherein the power supplied to the plasma during etching is greater than that during deposition.

38. A method according to claim 36 ~~or 37,~~ wherein the strength of the attenuation means may be varied for each of the deposition and/or etch steps.

39. A method according to ~~any one of claims 36 to 38~~ claim 36, wherein the attenuation means comprises means for creating an electromagnetic field which is reduced or switched off during the deposition step.

40. A method of etching a feature in a substrate in a chamber, the method comprising alternately etching the

substrate and depositing a passivation layer on the substrate, wherein neutral radicals during the etch step are guided by a guiding means to improve the uniformity of etching across the substrate.

41. A method according to claim 40, further comprising the step of reducing and/or homogenising the ion flux from the plasma, prior to the guiding of neutral radicals, substantially without affecting the radical number density.

42. A method according to claim 41, wherein the ion flux is reduced or homogenized during the etch step only.

43. A method of etching a feature in a substrate, the method comprising applying a pulsed high power to an etch source gas, and alternately etching the substrate and depositing a passivation layer on the substrate in a chamber.

44. A method according to claim 43, wherein the power density of the pulsed high power is between 10 and 300 W/cm^3.

45. A method according to claim 43 ~~or 44~~, further comprising the step of reducing and/or homogenising the ion flux from the plasma substantially without affecting the radical number density.

46. A method according to ~~any one of claims 43 to 45~~ claim 43, further comprising the step of guiding neutral radicals of the etch source gas to improve the uniformity of etching across the substrate.

47. A plasma processing apparatus for performing the method of ~~any one of claims 43 to 46~~ claim 43, the apparatus comprising a first chamber having an inlet for an etch source gas and a

second chamber having a support for a substrate, wherein the first and second chambers are connected via an aperture, and wherein the apparatus further comprises a means for providing pulsed high power to the first chamber.

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47. A plasma processing apparatus according to claim 46, further comprising attenuation means in the region of the aperture.

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48. A method of etching a feature in a substrate, the method comprising applying a high density radical source to an etch source gas, and alternately etching the substrate and depositing a passivation layer on the substrate in a chamber.

50. Any novel combination of the features of plasma processing apparatus or parts thereof or methods of substrate etching substantially as herein described and/or with reference to the accompanying drawings.